

INDEPENDENCE OF CONCURRENT RESPONDING MAINTAINED BY INTERVAL SCHEDULES OF REINFORCEMENT¹

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A pigeon's responses were reinforced on a variable-interval schedule on one key; and, concurrently, either a multiple or a fixed-interval schedule of reinforcement was in effect on a second key. These concurrent schedules, conc VI 3 (mult VI 3 EXT) or conc VI 3 FI 6, were programmed with or without a changeover delay (COD). Because the COD provided that responses on one key could not be followed by reinforced responses on the other key, responding on one key was not likely to accidentally come under the control of the reinforcement schedule on the other. When the COD was used, the performances on each key were comparable to the performances maintained when these interval schedules are programmed separately. The VI schedule maintained a relatively constant rate of responding, even though the rate of responding on the second key varied in a manner appropriate to the schedule on the second key. The mult VI 3 EXT schedule maintained two separate rates of responding: a relatively high rate during the VI 3 component, and almost no responding during the EXT component. The FI schedule maintained the gradually increasing rate of responding within each interval that is characteristic of the performance maintained by this schedule. The concurrent performances, however, did include certain interactions involving the local characteristics of responding and the over-all rates of responding maintained by the various schedules. The relevance of the present findings to an inter-response time analysis of VI responding, a chaining account of FI responding, and the concept of the reflex reserve was discussed.

When two different responses are reinforced concurrently by two independent schedules of reinforcement, the performance that is maintained by each schedule is often different from that which would have been obtained if the schedules had been programmed separately. For example, Ferster and Skinner (1957) have shown that a pigeon does not exhibit a typical fixed-interval performance when responses on one key are reinforced on a fixed-interval schedule while responses on a second key are reinforced concurrently on a variable-interval schedule. One reason appears to be that with concurrent schedules, a response on one key is occasionally followed by a reinforced response on the second key. Such reinforcement strengthens not only the response on the second key, for which it was programmed, but also the response on the first key and the behavior of switching from the first key to the second. Under these conditions, the first response will come under the control not only of its own schedule, but also of the schedule

programmed for the second response. This control of one response by the schedule for another is especially likely when both schedules are interval schedules, because the longer the pigeon responds on one key, the more time has passed during which the interval schedule on the other key may have set up a reinforcement, and therefore the more probable it is that the next response on the other key will be reinforced.

In the present experiments, a changeover delay (COD: *cf.* Herrnstein, 1961) was used during concurrent interval scheduling of reinforcement. The COD provided that responses on one key were always separated from subsequent reinforced responses on the other key by a certain minimal duration. The concurrent interval performances obtained with the COD were more similar to those resulting when interval schedules are programmed singly than were the performances without the COD. These findings have relevance not only for the analysis of concurrent interval performances, but also for the analysis of the performances maintained by singly programmed interval schedules.

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METHOD

Apparatus

Two 0.75-in. translucent pigeon-keys were mounted 4 in. apart, center to center, on one wall of the experimental chamber (*cf.* Ferster & Skinner, 1957). The key on the right was illuminated from behind by a green 6-watt lamp, and that on the left either by a red or by a yellow 6-watt lamp. The operation of either key produced a feedback click. Two 6-watt lamps (houselights) were mounted on the ceiling of the chamber and provided general illumination. The 2-in.-square opening to the reinforcement magazine was located below the keys and was centered between them. Reinforcement consisted of 4 sec of access to mixed grain. During reinforcements produced by responses on the right key, the magazine was illuminated and the key-lights and houselights were turned off. During reinforcements produced by responses on the left key, the magazine was illuminated, the key-lights were turned off, and a clicker operated at a rate of about 4 clicks per sec. The experimental chamber was enclosed in a sound-attenuating box. Programming and recording apparatus was located in a separate room.

Subjects

Six adult, male, White Carneaux pigeons were maintained at 80% of free-feeding body weight. Each had a history of responding (see Catania, 1961) under various concurrent schedules of reinforcement.

Procedure

During each daily 1-hr experimental session, two independent schedules of reinforcement, with or without a COD, were programmed on the two keys. The schedules are summarized in Table 1.

The COD was 0.5 sec (COD 0.5 sec) and, for each key, was timed from each response that followed a response on the other key. Thus, if the pigeon was responding on the right key and reinforcement had been set up on the left key, the first response on the left key and those following it within the next 0.5 sec were not reinforced. After the 0.5-sec delay, the next response on the left key produced reinforcement, unless the pigeon had switched back to the right key. In the latter case, the next response on the left key again

initiated a delay of 0.5 sec. A response on one key, therefore, was always separated from a subsequent reinforced response on the other by the time taken to change over from one key to the other, the 0.5-sec delay, and the time from the end of the delay to the reinforced response. The behavior during the changeover was always separated from a subsequent reinforced response by the 0.5-sec delay and the time from the end of the delay to the reinforced response.

Table 1
Schedules Used in Experiments I and II

<i>Schedule</i>	<i>COD</i>	<i>No. of Sessions</i>
Experiment I (Pigeons 82, 84, 89)		
conc VI 3 EXT	0.5 sec	15
conc VI 3 VI 3	0.5 sec	15
conc VI 3 (mult VI 3 EXT)	0.5 sec	12
conc VI 3 (mult VI 3 EXT)	No COD	12
conc VI 3 (mult VI 3 EXT)	0.5 sec	6
Experiment II (Pigeons 90, 91, 94)		
conc VI 3 FI 2.5	0.5 sec	48
conc VI 3 FI 6	0.5 sec	7
conc VI 3 FI 6	No COD	12
conc VI 3 FI 6	0.5 sec	12
conc VI 3 FI 10	0.5 sec	12

This COD is different from the one used by Findley (1958), which provided that a response on one key could not be reinforced unless it occurred more than n seconds after a response on the other key. Under the latter condition, the first response on one key after a response on the other could be reinforced if the pigeon took long enough to change over from one key to the other. The occasional reinforcement of this response could strengthen behavior occurring during the changeover, and therefore produce and maintain performances with long pauses between the responses on one key and subsequent responses on the other.

Experiment I: Conc VI (mult VI EXT). A 3-min variable-interval schedule (VI 3) was programmed for responses on the right, green key. A two-component multiple schedule was programmed concurrently for responses on the left key: one component was VI 3, with

a red key-light, and the other was extinction (EXT), with a yellow key-light. Each component of the multiple schedule lasted 2 min. The COD was discontinued for 12 sessions during the programming of this schedule.

In the earlier sessions, when EXT and then VI 3 were programmed on the left key concurrent with the VI 3 schedule on the right key, the left key was continuously red.

Experiment II: Conc VI FI. A VI 3 schedule was programmed for responses on the left, red key, while a fixed-interval schedule (FI)

was concurrently programmed for responses on the right, green key. Three different intervals were used, FI 2.5, FI 6, and FI 10. The COD was discontinued for 12 sessions during the programming of conc VI 3 FI 6.

RESULTS

Experiment I: Conc VI (mult VI EXT)

Figure 1 shows cumulative records of the responding of Pigeon 84 on conc VI 3 (mult

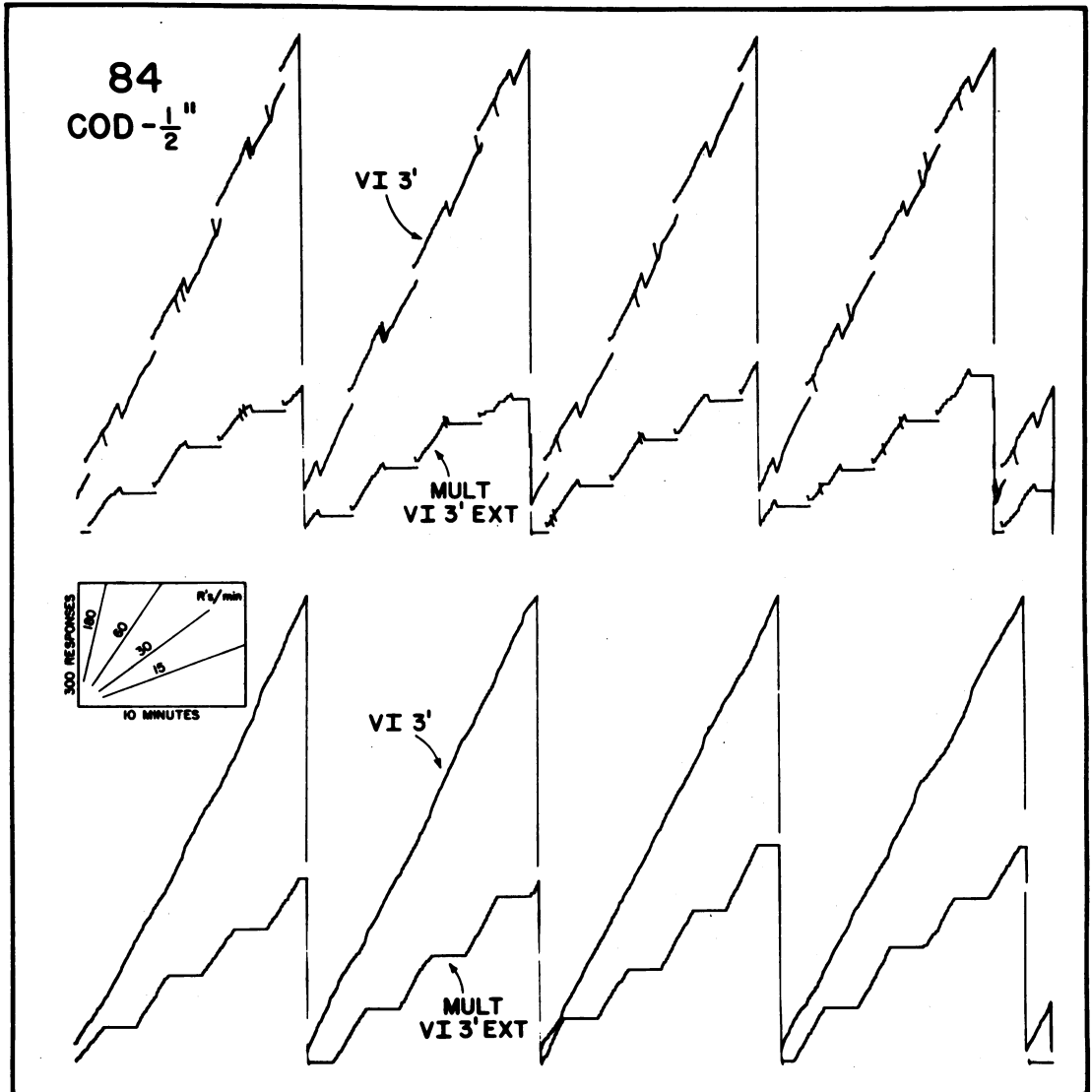


Fig. 1. Cumulative records of the performance of Pigeon 84 during two full sessions of conc VI 3 (mult VI 3 EXT) with COD 0.5 sec. In the upper pair of records, both recording pens were displaced downward during the EXT component of the multiple schedule, and reinforcements were indicated by diagonal strokes. In both pairs of records, the recording pens reset to the base line simultaneously.

VI 3 EXT) with COD 0.5 sec. In the upper pair of records, a downward displacement of both recording pens indicated the EXT component of the multiple schedule, and diagonal strokes indicated reinforcement. These markings were omitted in the lower pair; only responses were recorded.

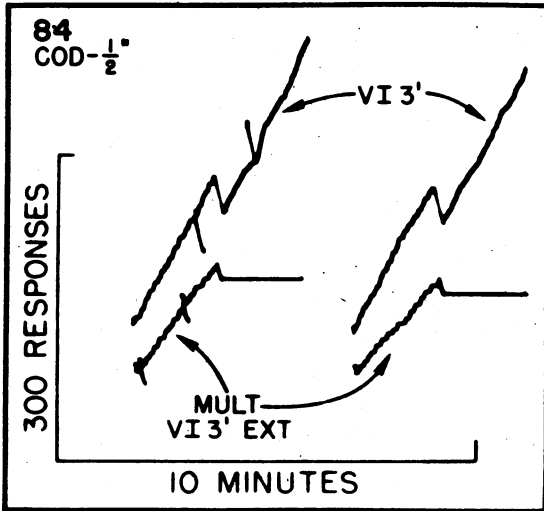


Fig. 2. Details from a cumulative record of the performance of Pigeon 84 during a session of conc VI 3 (mult VI 3 EXT) with COD 0.5 sec. Both recording pens were displaced downward during the EXT component of the multiple schedule. Reinforcements were indicated by diagonal strokes.

The records for the key on which the multiple schedule was programmed (the mult key) show the two separate rates of responding appropriate to that schedule: maintained responding during the VI component, and almost no responding during the EXT component. [For these pigeons, responding to a yellow key had already been extinguished (Catania, 1961), so that the rate of responding on the left key during the EXT component was almost zero even in the initial sessions of multiple scheduling.] On the key on which VI 3 was programmed (the VI key), a fairly constant rate of responding was maintained during both components of the multiple schedule; about the same number of responses were made on the VI key during the 2-min periods of VI 3 on the mult key as during the 2-min periods of EXT on the mult key.

Figure 2 shows details of cumulative records for Pigeon 84. During the VI component of

the mult-key schedule, the steplike grain of the records for both keys indicated that responding on each key occurred at a high local rate but was frequently interrupted by periods of responding on the other key. During the EXT component of the mult-key schedule, responding was almost completely restricted to the VI key; and the relatively continuous responding on the VI key produced a more smooth-grained record. The over-all rate of responding on the VI key remained constant even though the local characteristics of the VI performance during the two components of the mult-key schedule were different.

Figure 3 shows responding during a full session without COD. For both keys, the steplike grain during the VI component of the mult-key schedule was less marked, because switching from one key to the other was more frequent than when the COD was in effect. With no COD, switching was strengthened because it was followed occasionally by a reinforced response.

Except for the difference in grain, the record for the mult key was about the same as the mult-key records in Fig. 1. However, the record for the VI key differed from those with the COD, not only in grain, but also in the rates of responding during the two components of the mult-key schedule. The rate of responding on the VI key during the EXT component became higher than the rate of responding during the VI component. For all three pigeons, this separation of the response rates on the VI key occurred within three or four sessions after the removal of the COD.

Figure 4, which contains details of records from Pigeon 82, shows another effect of the removal of the COD. The performance with the COD (I) was comparable with that in Fig. 1 and 2. Without the COD (II), the grain of the records changed and the VI-key response rates during the two mult-key components separated, as in Fig. 3. In addition, responding on the mult key began to occur during the EXT component. Without the COD, these responses could occasionally be followed by reinforced responses on the VI key. The increase in mult-key responding during the EXT component did not occur for Pigeons 84 and 89, but probably would have if sessions without the COD had been continued. Because responses on the mult key occurred only rarely during EXT, the prob-

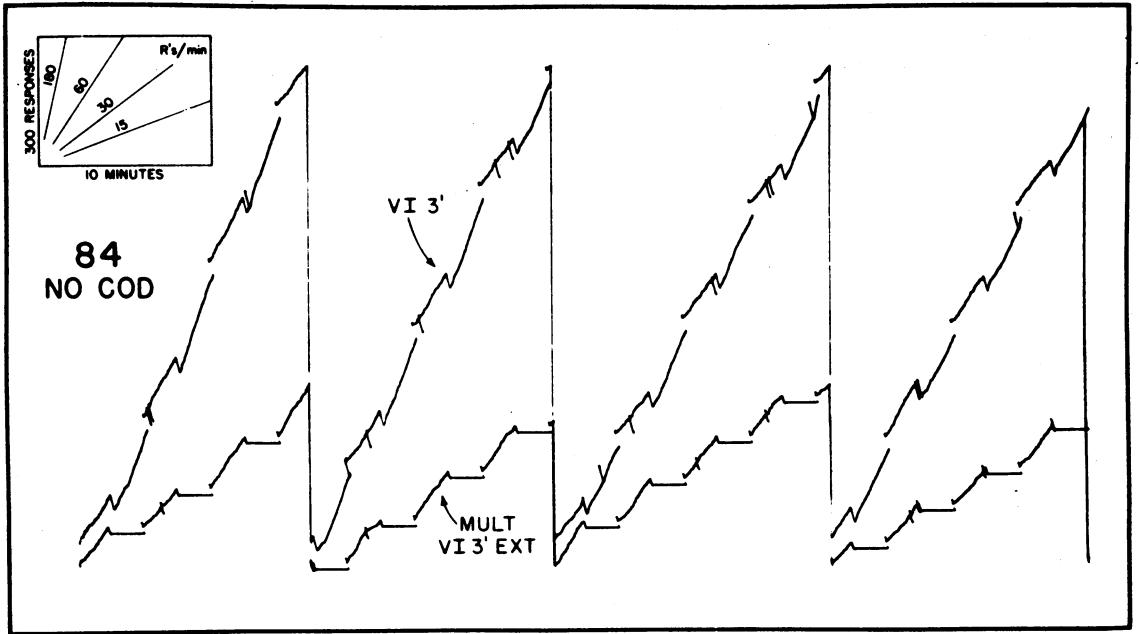


Fig. 3. Full session of conc VI 3 (mult VI 3 EXT) with no COD for Pigeon 84.

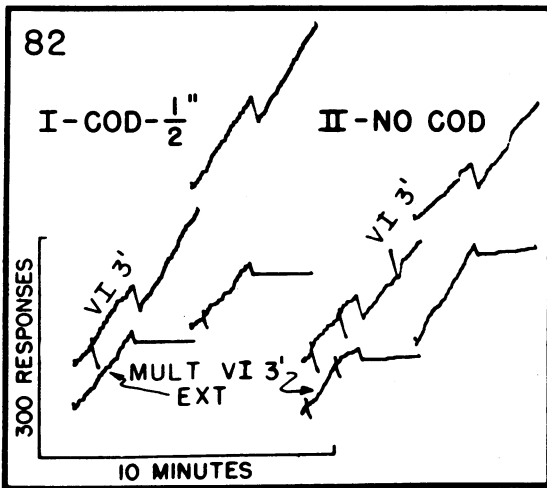


Fig. 4. Detail of conc VI 3 (mult VI 3 EXT) with COD 0.5 sec (I) and with no COD (II) for Pigeon 82.

ability was low that they would be followed, within only twelve sessions without COD, by reinforced responses on the VI key that could strengthen them.

For each pigeon, the performance with the COD was recovered within three or four sessions after the COD was reinstated.

Table 2 shows the responses on each key during each component of the mult-key sched-

ule, in responses per half-hour of each component. The table includes, for each pigeon, the last three of twelve sessions with COD and the last three of twelve sessions without COD. When the COD was used, responses on the

Table 2

Responses per half-hour during Full Sessions of Conc VI 3 (mult VI 3 EXT) with and without COD*

COD 0.5 sec				No COD			
VI key		mult key		VI key		mult key	
VI	EXT	VI	EXT	VI	EXT	VI	EXT
(Pigeon 82)							
1503	1513	1814	4	1087	1432	1709	31
1242	1254	1777	5	1221	1759	1686	19
1379	1210	1606	2	1034	1626	1782	14
(Pigeon 84)							
2328	2410	1725	8	1849	2799	1277	0
2292	2169	1867	4	1659	2680	1499	2
2013	2191	2097	2	1747	2533	1175	1
(Pigeon 89)							
1217	1278	1784	1	1034	1357	1063	0
1212	1298	1913	4	1075	1375	1051	3
1198	1316	1458	2	1128	1417	1045	1

*Responses during the VI and EXT components are shown separately.

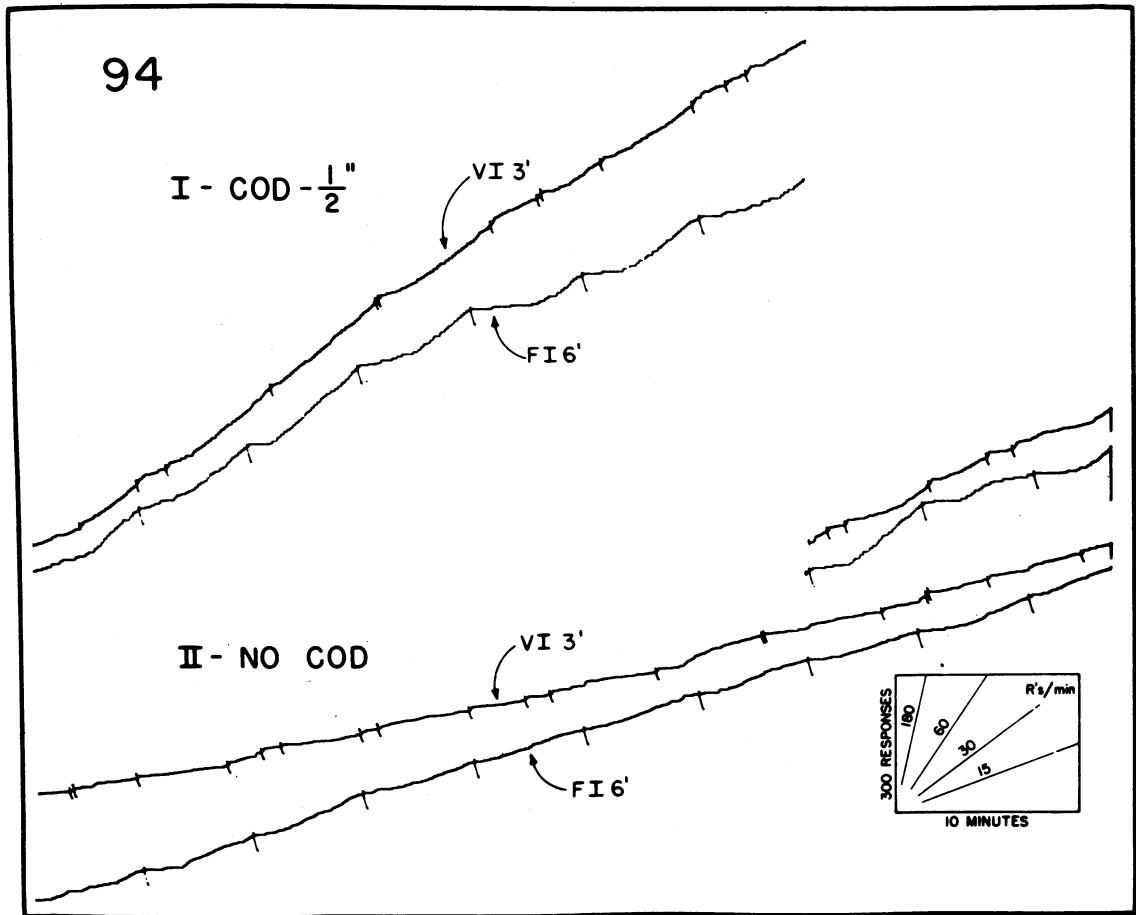


Fig. 5. Full sessions of conc VI 3 FI 6 with COD 0.5 sec (I) and with no COD (II) for Pigeon 94.

VI key during the VI and the EXT components were about equal. The occasional large differences that were observed (e.g., the last sessions for Pigeons 82 and 89 in Table 2) were as likely to be in one direction as in the other. After the first three or four sessions with no COD, more responses on the VI key occurred, without exception, during the EXT component than during the VI component.

Experiment II: Conc VI FI

Figure 5 shows cumulative records of full sessions for Pigeon 94 on conc VI 3 FI 6 with COD 0.5 sec (I) and with no COD (II). With the COD, a fairly good FI performance was maintained on the key on which the FI schedule was programmed (the FI key), while a relatively constant rate of responding was maintained on the VI key. Curvature was evi-

dent in the VI record for Pigeon 94, but it tended to be correlated with VI reinforcements and not with the FI reinforcements on the other key.

Occasional irregular intervals occurred on the FI key (e.g., the last complete interval in Fig. 5-I); however, such intervals are often noted, even when FI schedules are programmed alone.

Both the VI and the FI records show the steplike grain indicating that responding on one key was frequently interrupted by periods of responding on the other.

Without the COD, the conc VI 3 FI 6 records (II) were comparable with records of conc VI 2 FI 2 in Ferster and Skinner (1957, Fig. 905, p. 709). The grain of the records became smoother than with the COD, indicating an increased frequency of switching

from one key to the other. In addition, the curvature in the FI record was considerably reduced. Without the COD, responding early in each fixed interval could be maintained by the occasional succession of response on the FI key and reinforcements for responses on the VI key. The responding on the FI key could thus come partially under the control of the VI schedule.

For all three pigeons, the effects of the removal of the COD and the later recovery of the performance with the COD occurred within three or four sessions.

In Fig. 6, details of the responding with the COD show that the grain of the VI-key record became more steplike as responding on the FI key became more frequent. Interruptions of the responding on the VI key by FI-key responding were longer or occurred more frequently as each fixed interval progressed. Nevertheless, the over-all rate of responding on the VI key remained roughly constant.

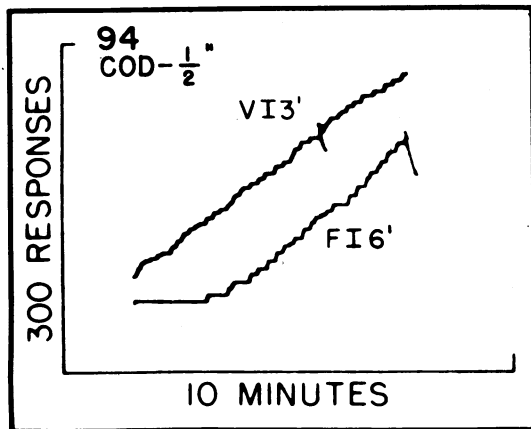


Fig. 6. Detail of conc VI 3 FI,6 with COD 0.5 sec for Pigeon 94.

Figure 6 also shows a high rate of responding on the VI key at the beginning of the record, immediately after the preceding FI reinforcement. In addition, after a reinforcement for a response on the VI key, a pause occurred in the responding on the FI key. Figure 5-I included other instances of responding on the VI key and pausing on the FI key after reinforcements on either key. These effects of reinforcement on subsequent responding were not markedly altered by removal of the COD.

In the present experiments, reinforcements for responses on the FI key were made differ-

ent from those for responses on the VI key (see Apparatus). This was done because with FI schedules, reinforcement may function as a discriminative stimulus for the pause at the beginning of each interval. The finding that VI-key and FI-key reinforcements had effects on subsequent responding on both keys suggests that the difference provided was not fully effective, but no attempt was made to systematically examine the role of the difference between the two reinforcements.

As Fig. 5-II shows, FI-key responding tended to follow the reinforcement schedule on the VI key when the COD was discontinued for Pigeon 94. For Pigeon 91, curvature in the FI record was maintained for a longer time, but the VI-key performance began to follow the FI schedule. This is illustrated in Fig. 7, which contains sections of records from the third session without the COD (I) and from the third session after the COD was reinstated (II). The effect did not last: responding on the FI key later began to follow the VI schedule. When the COD was reinstated (II), responding on the two keys again separated, although responding after reinforcement on the FI key continued for some time. Despite

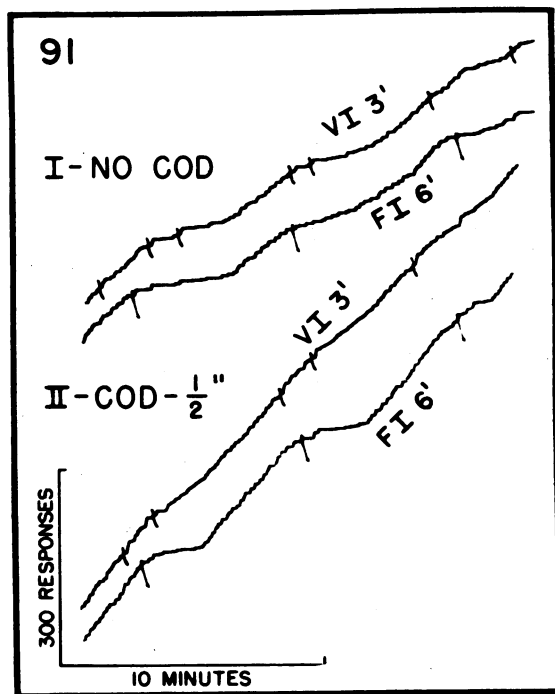


Fig. 7. Details of conc VI 3 FI 6 with no COD (I) and with COD 0.5 sec (II) for Pigeon 91.

the large changes in the rate of responding on the FI key during each interval, the rate of responding on the VI key was again fairly constant with the COD in effect.

Figure 8 shows details of records for Pigeon 90. This bird showed the most consistent curvature on the FI key and the most constant rate of responding on the VI key. The FI 2.5 performance had been allowed to develop while the COD was in effect, and the VI 3 schedule was programmed concurrently on the other key. The transition to FI 6 (II) and later to FI 10 (III) was fairly rapid. The performance with FI 6 during an early session without COD (IV) is included. It shows that for this pigeon, the FI curvature disappeared completely when the COD was removed. With each of the different fixed-intervals, the grain

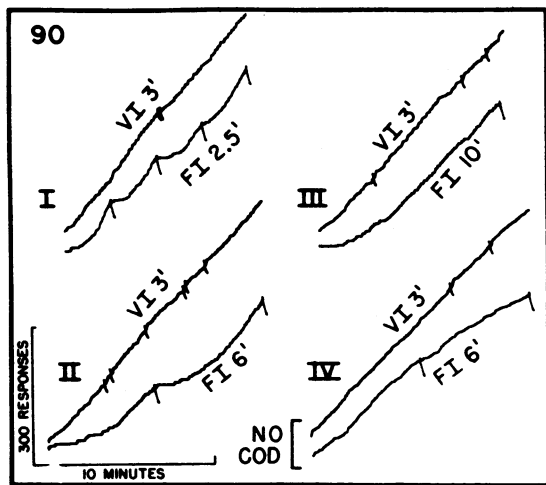


Fig. 8. Details of conc VI 3 FI with COD 0.5 sec and three different FI's for Pigeon 90; FI 6 is also shown with no COD (IV).

of the VI record was correlated with the concurrent rate of responding on the FI key; but under all conditions, a roughly constant overall rate of responding was maintained on the VI key.

The Rate of Responding Maintained by VI 3

When responses on the VI key were separated in time from subsequent reinforcement for responses on the other key by the COD, the over-all rate of responding on the VI key did not appear to vary with the amount of concurrent responding on the other key. However, the level at which the constant rate of

responding on the VI key was maintained was in part determined by the frequency of reinforcement programmed on the other key. This is indicated for each pigeon in Table 3, which shows the rate of responding maintained by VI 3 with each of three different schedules programmed concurrently on the second key. With one exception (the reversal of FI 6 and FI 10 for Pigeon 90), the more frequent the reinforcement provided by the schedule on the other key, the lower the rate of responding maintained by VI 3 on the VI key. Thus, when mult VI 3 EXT was programmed on the other key, the rate of responding maintained on the VI key was lower than with EXT on the other key, and higher than with VI 3 on the other key. Similarly, when FI 6 was programmed on the other key, the rate of responding maintained on the VI key was lower than with FI 10 on the other key, and higher than with FI 2.5 on the other key. In general, as the frequency of reinforcement provided by the other schedule increased, the rate of responding maintained by the VI schedule decreased. Nevertheless, given that within a certain context of schedules a certain rate of responding was generated by the schedule on the VI key, the COD then provided that this rate of responding was main-

Table 3

Responses per Minute Maintained by VI 3 (the VI key), with other Schedules Programmed Concurrently on a Second Key*

Pigeon	Schedule on the Second Key			
	VI 3	mult VI 3 EXT	EXT	mult VI 3 EXT No COD
	(20)	(10)	(0)	(10)
82	44	45	57	45
84	70	74	86	74
89	35	42	58	41
	FI 2.5	FI 6	FI 10	FI 6—No COD
	(24)	(10)	(6)	(10)
90	43	48	47	35
91	33	37	42	29
94	22	25	26	18

*Numbers in parentheses indicate reinforcement per hour provided by the schedule on the second key. Each response rate is based on the last 3 of at least 12 sessions of a given concurrent schedule.

tained independently of the amount of concurrent responding on the other key.

Table 3 indicates that with FI on the other key, the removal of the COD produced a decrease in the over-all rate of responding maintained on the VI key. The rate of responding on the FI key also decreased (*cf.* Fig. 5 and 7). In the table, an effect of the removal of the COD on the conc VI (mult VI EXT) performance is not apparent, but the rate shown is the average of the two separated VI-key rates. Comparison with Table 2 shows that, although the average rate on the VI key was unchanged by the removal of the COD, the rate of responding decreased on both the VI key and the mult key during the VI component of the multiple schedule. These rate decreases may be attributed to the strengthening of behavior during the changeover by the occasional reinforcement of responses that followed immediately upon the changeover. With behavior during the changeover strengthened in this way, the pigeons spent more time in the changeover from one key to the other, and less in responding on one or the other key, than when the COD was in effect. Such strengthening of behavior during the changeover could not occur during the EXT component in conc VI (mult VI EXT) because changeovers during this component were very infrequent.

DISCUSSION

The COD separated in time the responses on one key and subsequent reinforcement for responses on the other, so that a schedule on one key was not likely to control responding on the other. In effect, the COD eliminated superstitiously maintained chaining of responding on the two keys (*cf.* Skinner, 1948). In so doing, the COD provided for a certain degree of independence between the two performances. The independence was by no means complete, however, and it may therefore be of value to consider which aspects of the responding maintained by interval schedules may remain invariant with changes in the schedule programmed concurrently on a second key. For the present purposes, three aspects of a performance may be distinguished: local characteristics, shown by the grain of a cumulative record or by distributions of inter-response times; level, or the over-all rate of responding maintained by

a schedule; and gross characteristics, shown by the over-all form of the cumulative record, as, for example, the curvature in records of FI performances.

Complete independence of the local characteristics of performances requires compatible responses; otherwise, the occurrence of one response implies the nonoccurrence of the other at that moment. But, at least with interval schedules, even responses that are topographically incompatible require a COD if responding on one key is not to come under the partial control of the schedule on the other. One effect of the COD is the steplike grain of concurrent records, because with the COD, several successive responses are made on each key after each changeover from the other. With such performances, the local characteristics of the responding on one key cannot be independent of the local characteristics of the concurrent responding on the other. The two responses, which were incompatible in the first place, have been made even more incompatible by the conditions for reinforcement imposed by the COD. The necessity of a COD or equivalent procedure either for compatible or for incompatible responses maintained by concurrent interval schedules therefore implies that independence of the local characteristics of the performances is not to be expected.

Independence of level presents a different kind of problem. The data indicate that the level of responding a given schedule maintains is partly determined by the context of schedules within which it is programmed. The rate of responding a given schedule maintains decreases as the frequency of reinforcement provided by a second schedule increases.

It may be argued that these changes in the level maintained by a schedule are accounted for by changes in the time spent in responding on the second key when the schedule on that key is varied. However, the constant over-all rate of responding maintained by VI 3 suggests that time spent in responding on the second key did not limit the rate maintained on the VI key. With the COD in effect, the pigeon did not respond at a lower rate on the VI key when responding at a high rate on the other than when not responding at all on the other.

The occurrence of interactions of level within multiple schedules (Reynolds, 1961a)

challenges the argument that the time spent in responding on one key affects the level on the other because the component schedules in multiple schedules are programmed successively rather than simultaneously. Thus, changes in level probably must be attributed to variables that have not been considered here. Herrnstein (1961), for concurrent schedules, and Reynolds (1961b), for multiple schedules, have indicated the importance of relative frequency of reinforcement for the analysis of interactions of level. The implication is that the possibility of independence with respect to level must be ruled out for the present.

With the COD, however, at least the gross characteristics of the performances generated by interval schedules are independent. The VI 3 schedule maintained a relatively constant rate of responding on one key while fairly characteristic multiple and FI performances were maintained on a second key. These findings are pertinent not only to the analysis of concurrent performances, but also to the analysis of interval schedules in themselves. In particular, the present data present difficulties for both inter-response time (IRT) and chaining analyses of the responding maintained by interval schedules. The analysis of VI responding in terms of the selective reinforcement of IRT's (Anger, 1956) must account for the constant rate maintained on one key by a VI schedule while the local characteristics of the VI performance, necessarily including the distribution of IRT's, are changing with the amount of responding on the second key. The analysis of FI responding as a chain of responses, in which the rate of responding at each moment provides the discriminative stimulus for the slightly higher rate that follows, must account for the maintenance of a chain that is frequently interrupted by periods of responding on the second key.

As a final point, the present findings indicate that within a given context of schedules, a VI schedule generates a fixed number of responses over a given interval of time. This number does not increase when less time in this interval is spent in the responding on a second key. To paraphrase Parkinson (1957), this fixed response output expands so as to fill the time available for its completion. This statement holds at least for the limited range

of situations discussed here. But it is also not unrelated to the concept of the reflex reserve (Skinner, 1938), because it implies the compensations in response rate (brief high rates of responding after pauses and pauses after brief periods of high rate) that were among the observations that led to the use of the concept of the reserve.

Whether this concept has relevance for a more general account of the performances maintained by interval schedules remains to be seen, because an alternate account of the present findings must also be considered. With concurrent interval schedules, the longer the pigeon responds on one key, the more likely it is that reinforcement has been set up for a response on the other. The higher probability of reinforcement for responding on one key after a period of responding on the other might be expected to generate a higher local rate of responding than when the responding has not been preceded by a period of responding on the other key. The higher local rate generated in this way could compensate for the shorter time spent in responding on the key.

REFERENCES

- Anger, D. G. The dependence of interresponse times upon the relative reinforcement of different inter-response times. *J. exp. Psychol.*, 1956, **52**, 145-161.
- Catania, A. C. Behavioral contrast in a multiple and concurrent schedule of reinforcement. *J. exp. Anal. Behav.*, 1961, **4**, 335-342.
- Ferster, C. B., and Skinner, B. F. *Schedules of reinforcement*. New York: Appleton-Century-Crofts, 1957.
- Findley, J. D. Preference and switching under concurrent scheduling. *J. exp. Anal. Behav.*, 1958, **1**, 123-144.
- Herrnstein, R. J. Relative and absolute strength of response as a function of frequency of reinforcement. *J. exp. Anal. Behav.*, 1961, **4**, 267-272.
- Parkinson, C. N. *Parkinson's law*. Boston: Houghton Mifflin, 1957.
- Reynolds, G. S. An analysis of interactions in a multiple schedule. *J. exp. Anal. Behav.*, 1961, **4**, 107-114. (a)
- Reynolds, G. S. Relativity of response rate and reinforcement frequency in a multiple schedule. *J. exp. Anal. Behav.*, 1961, **4**, 179-184. (b)
- Skinner, B. F. *The behavior of organisms*. New York: D. Appleton-Century Co., 1938.
- Skinner, B. F. 'Superstition' in the pigeon. *J. exp. Psychol.*, 1948, **38**, 168-172.

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